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Original article

Is rotator cuff repair appropriate in patients older than 60 years of age? Prospective, randomised trial in 103 patients with a mean four-year follow-up



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ABSTRACT

Background: The objective of this randomised trial was to compare surgical rotator cuff repair to simple decompression by acromioplasty and biceps tenotomy in patients older than 60 years of age with a mean follow-up of 4 years.

Hypothesis: Tendon repair produces better functional outcomes than simple decompression and prevents progression towards cuff tear arthropathy in the longer term.

Patients and method: Of 130 initially included patients older than 60 years of age and having rotator cuff tears deemed amenable to surgical repair, 103 (79%) were evaluated after a mean of 4 years. These patients had been randomly allocated to acromioplasty and tenotomy (AT group, $n=49$) or to acromioplasty, tenotomy, and tendon suture (CR group, $n=54$). The tear was distal in 41 patients, intermediate in 40, and retracted in 22. At last follow-up, the evaluation included the clinical Constant's Score, radiographs and, in the CR group, ultrasonography.

Results: The complication rate was 4%. The mean Constant Score was 44 preoperatively; values after 4 years were 76 overall ($P=0.01$), 78 in the CR group, and 73 in the AT group ($P=0.01$). The tendon-healing rate as assessed using ultrasonography was 63%. The Constant Score was significantly better when tendon healing was achieved (82/73, $P<0.001$). In the AT group, the acromio-humeral distance was significantly shorter (6.9 mm/7.8 mm, $P=0.03$) and eccentric humeral head position was more common (44%/26%, $P=0.01$).

Discussion: Arthroscopic rotator cuff repair provides better functional outcomes than does simple decompression in patients older than 60 years and prevents cuff tear arthropathy with eccentric humeral head position in the medium term. Tendon healing is the main determinant of outcomes after rotator cuff repair.

Level of evidence: II, randomised trial.

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1. Introduction

Rotator cuff tears are common in older individuals [1]. Although usually asymptomatic, they are often diagnosed during a workup for shoulder pain. The frequency of this clinical situation contrasts with the lack of certainty regarding the best management options. Good outcomes obtained after simple decompression surgery [2,3], together with the tendon healing impairments seen with advancing age [4,5], may cast doubt on the benefits of tendon suture. At

the 1998 SOFCOT symposium, rotator cuff repair was deemed inadvisable after 65 years of age and a case-by-case discussion of the treatment indications was recommended for patients aged 55 to 65 years.

Nevertheless, in the absence of tendon suture, the humeral head position becomes eccentric and functional impairments develop eventually [2,3,6,7]. The development over the past decade of arthroscopic techniques has diminished the invasiveness of tendon repair surgery, which is now easily performed in elderly patients. In addition, older individuals now enjoy many more years of good health than previously and are often physically active or even regular sports participants who therefore have a strong demand for good function. Mean patient age in published case-series

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studies of cuff repair has increased in recent years [8–13]. However, although these studies showed good outcomes, they failed to demonstrate that tendon suture was superior over simple decompression surgery.

Our main hypothesis was that tendon suture in addition to decompression (acromioplasty and biceps tenotomy) would produce better functional outcomes than decompression alone in patients who were older than 60 years at surgery and who were reevaluated 4 years later. We also hypothesised that tendon healing might be associated with better function and that tendon suture might prevent gradual loss of humeral head centring in the long-term. This study extends our previously published data obtained after 1 year of follow-up [14].

2. Patients and method

2.1. Patients

We conducted a single-centre randomised trial between February 2007 and July 2008. We included patients older than 60 years with rotator cuff tears involving the supraspinatus tendon with or without an extension to the infraspinatus tendon, confirmed by magnetic resonance imaging (MRI) or computed arthrotomography (CT-arthrography) and considered amenable to repair based on radiological findings (fatty degeneration < stage 3 and centred humeral head) and intraoperative criteria (reducibility of the tendon). Exclusion criteria were previous surgery on the involved shoulder, concomitant sub-scapularis tendon tear, spontaneous tear of the long head of biceps tendon (LHBT), pseudo-paralysis or stiffness of the shoulder, gleno-humeral osteoarthritis, eccentric humeral head, or fatty degeneration > stage 2 according to Goutallier et al. [15]. With alpha set at 0.05, 130 patients were needed to obtain 80% statistical power.

The 130 included patients were allocated at random to acromioplasty and tenotomy only (AT group, $n = 60$) or to AT plus tendon suture (CR group, $n = 70$). Randomisation occurred on the day before surgery and the patients were then informed about the type of procedure they would receive. In all, 103 (79%) patients were reevaluated during a visit after a mean follow-up of 4 years (range, 3–5), including 54 in the CR group and 49 in the AT group. Of the 27

patients who were not reevaluated, 6 had died and 21 had been lost to follow-up or were unable to travel to our centre, usually because of unrelated health problems.

Our study population of 103 patients included 53 women and 50 men with a mean age of 68 ± 5.1 years (range, 60–82 years) at surgery. The tear was on the dominant side in 75 (73%) patients. Preoperatively, the mean Constant Score was 44 ± 12.8 (range, 18–73), the mean acromio-humeral distance (AHD) was 8.3 ± 1.6 mm (range, 6–12 mm), and the humeral head was always centred. The arthroscopic evaluation of the tear conducted according to Thomazeau et al. and Bernageau [16,17] showed 42 distal, 39 intermediate, and 22 retracted tears. None of the preoperative parameters studied showed statistically significant differences between the two groups (Table 1).

2.2. Operative technique and postoperative care

All patients underwent arthroscopic surgery in the lateral decubitus position. Evaluation of the gleno-humeral joint then of the subacromial area provided detailed information on the tear in the coronal and sagittal planes. Exclusion criteria (sub-scapularis tear, spontaneous LHBT tear, and irreparable tear) were sought. LHBT tenotomy flush with the glenoid attachment and decompression acromioplasty were performed in all patients in both groups. In the CR group, tendon suture was consistently achieved using metal anchors inserted into the tip of the greater tuberosity after abrasion of the footprint, in a single-row ($n = 21$) or double-row ($n = 33$). The number of anchors used was recorded. All procedures were performed by one of three senior surgeons (OR, FS, DM).

Partial immobilisation was achieved by wearing a simple sling for 4 weeks. A passive self-rehabilitation programme was taught to all patients on day 1 and started immediately, with simple oral analgesics. Hospital-stay length was recorded for each patient. After 4 weeks, physiotherapy sessions were prescribed if needed.

2.3. Method

At last follow-up, all patients were assessed by an observer who was independent from the surgeon. The clinical evaluation included passive and active motion range measurements, cuff testing,

Table 1
Demographic data of the study patients.

	Overall	AT group	CR group	P value (CR vs. AT)
Number of patients	103	49	54	
Mean age	68 ± 5.1 (60.6–81.5)	69 ± 5.6 (60.6–81.3)	67 ± 4.5 (61–81.5)	0.15
Males/females	50 (49%)/53 (51%)	24 (49%)/25 (51%)	26 (48%)/28 (52%)	0.85
Dominant side involved	75 (73%)	33 (67%)	41 (76%)	0.26
Preoperative Constant Score	44 ± 12.8 (18–73)	43.5 ± 12.4 (18–68)	44 ± 13.2 (19–73)	0.84
Pain	5.4 ± 2.8 (0–10)	5.5 ± 2.8 (0–10)	5.2 ± 2.8 (0–10)	0.59
Activity level	9.4 ± 3 (2–17)	9.7 ± 2.8 (4–17)	9.2 ± 3.2 (2–16)	0.42
Range of motion	22.8 ± 7.7 (6–38)	22 ± 7.4 (6–36)	23.5 ± 8 (8–38)	0.34
Strength	6.1 ± 3.3 (0–18)	6.3 ± 3.4 (2–18)	5.9 ± 3.2 (1–16)	0.54
Acromio-humeral distance	8.3 ± 1.6 (6–12)	8.2 ± 1.7 (6–12)	8.3 ± 1.5 (6–13)	0.38
Distal tear	42 (41%)	21 (43%)	21 (39%)	
Intermediate tear	39 (38%)	20 (41%)	19 (35%)	0.51
Retracted tear	22 (21%)	8 (16%)	14 (26%)	
Operative time (minutes)	37 ± 20.2 (10–90)	20 ± 6.1 (10–40)	53 ± 14.8 (20–90)	<0.001
Physical therapy	73 (71%)	28 (58%)	45 (85%)	0.003

AT: acromioplasty and tenotomy only; CR: acromioplasty, tenotomy, and tendon suture.

Table 2
Functional outcomes.

Constant Score	Preoperative	Postoperative		<i>P</i> value	Healed (<i>n</i> = 34)	Not healed or not sutured (<i>n</i> = 68)	<i>P</i> value
		CR group (<i>n</i> = 54)	AT group (<i>n</i> = 48)				
Overall	44 ± 12.8 (18–73)	78 ± 8 (53–95)	73 ± 11.4 (39–87)	0.01	82 ± 6.2 (67–95)	73 ± 10.5 (39–85)	<0.001
Distal	46 ± 12.1 (22–73)	80 ± 6.7 (66–91)	79 ± 5.6 (67–87)	0.66	81 ± 6.2 (70–91)	78 ± 5.9 (66–87)	0.14
Intermediate	41 ± 13.9 (19–73)	77 ± 8.4 (53–89)	69 ± 12 (43–87)	0.03	80 ± 6.1 (67–89)	69 ± 11.2 (43–84)	<0.001
Retracted	43 ± 11.5 (18–66)	79 ± 9 (63–95)	71 ± 15.5 (39–84)	0.14	84 ± 6.1 (75–95)	72 ± 12.4 (39–85)	<0.01

AT: acromioplasty and tenotomy only; CR: acromioplasty, tenotomy, and tendon suture.

evaluation of the Constant Score [18], and a satisfaction questionnaire with four response options (very satisfied, satisfied, somewhat satisfied, dissatisfied). At last follow-up, radiographs were obtained, including an anteroposterior view, a Liotard view, and a Y view as described by Lamy (at a 1:1 scale) for AHD measurement and evaluation of eccentric humeral head position as described by Hamada et al. [19]. In the CR group, tendon healing was assessed using ultrasonography by a radiologist with extensive experience in osteo-articular ultrasonography, who used the same machine for all patients. Failed tendon healing was defined as clear visibility of the tendon tear or heterogeneity of the tendon attachment. One patient in the AT group was excluded from the final statistical analysis, as revision surgery was performed 2 years after the primary procedure. Thus, the comparative analysis rests on 102 patients.

All statistical tests were performed using Statview® software (Optima, Mérignac, France). Means are provided with the standard deviation and range. The Chi² contingency test was performed to compare qualitative variables and the Student *t*-test to compare quantitative variables. For all analyses, differences were considered significant when *P* < 0.05.

3. Results

Complications occurred in 4/103 (4%) patients: 2 patients experienced brachial plexus neurapraxia followed by a spontaneous full recovery, and 2 other patients had joint stiffness persisting more than 1 year after the surgical procedure. No cases of postoperative infection were recorded. The complication rate was not different between the two treatment groups. In the AT group, 1 patient experienced recurrent pain after a fall 2 years after the initial procedure and underwent surgical cuff repair; the Constant Score was 78 at last follow-up. As this result was unrelated to the initial procedure, it was excluded from the final statistical analysis.

Mean hospital-stay length was 2.2 days in the AT group and 3.2 days in the CR group (*P* < 0.001). In the CR group, the mean number of anchors used was 2.6 (range, 1–5). Mean operative time was 53 ± 14.8 minutes (range, 20–90 minutes) in the CR group and 20 ± 6.1 minutes (range, 10–40 minutes) in the AT group (*P* < 0.001).

Treatment by a physical therapist was significantly more common in the CR group (85% vs. 58%, *P* < 0.01).

The mean Constant Score improved significantly, from 44 ± 12.8 (range, 18–73) preoperatively to 76 ± 10 (range, 39–95) after a mean follow-up of 4 years (*P* < 0.001). The improvements involved the full range of score components. Of the 103 patients, 95% were satisfied or very satisfied with the outcome, and the 5 (5%) patients whose subjective result was less satisfactory were all members of the AT group. Table 2 reports the functional outcomes in each treatment group. The mean Constant Score at last follow-up was significantly better in the CR group (78 vs. 73, *P* = 0.01). The absence of additional benefits from tendon suture in patients with small tears contrasted with significant benefits in those with intermediate tears. In the subgroup of retracted tears, the difference was not statistically significant (79 vs. 71, *P* = 0.14), probably because of the small sample size.

Ultrasonography of the sutured tendons in the CR group showed a healing rate of 63% overall, 67% for distal tears, 63% for intermediate tears, and 57% for retracted tears; although these data suggest an adverse effect of retraction on healing, the trend was not statistically significant. We compared the functional outcomes between the 34 patients with healed tendons and the 68 patients with persistent tendon damage (defined as either no tendon suture or repeat tendon tear). None of the preoperative study variables was significantly different between these two groups. The mean final Constant Score in the group with healed tendons was 82 (range, 67–95) compared to 73 (39–85) in the group with persistent tendon damage (*P* < 0.001). This difference was larger than between the AT and CR groups. In addition, the differences were significant for the intermediate tear and retracted tear subgroups, although the difference for the distal tears was not significant (Table 2).

The analysis of the radiographs (Table 3) indicated a significant AHD decrease in the AT group (8.2 vs. 6.9, *P* = 0.002) contrasting with little change in the CR group (8.5 vs. 7.8, *P* = 0.1). At last follow-up, the AHD was significantly smaller in the AT group (6.9 vs. 7.8, *P* = 0.03), which had a significantly larger proportion of patients with an eccentric humeral head (Hamada > 1: 44% vs. 26%, *P* = 0.01). The mean Constant Score was 78 and 72 in the groups with a centred and an eccentric humeral head, respectively (*P* = 0.02).

Table 3
Radiographic outcomes.

	Acromio-humeral distance (mm)			Eccentric humeral head position (Hamada > 1)
	Preoperative	After 4 years	<i>P</i> value	
AT group	8.2 ± 1.7 mm (6–12)	6.9 ± 2.3 mm (2–12)	0.002	<i>n</i> = 21 (44%)
CR group	8.5 ± 1.5 mm (6–13)	7.8 ± 2.2 mm (2–13)	0.1	<i>n</i> = 14 (26%)
<i>P</i> value	0.38	0.03		0.01

AT: acromioplasty and tenotomy only; CR: acromioplasty, tenotomy, and tendon suture.

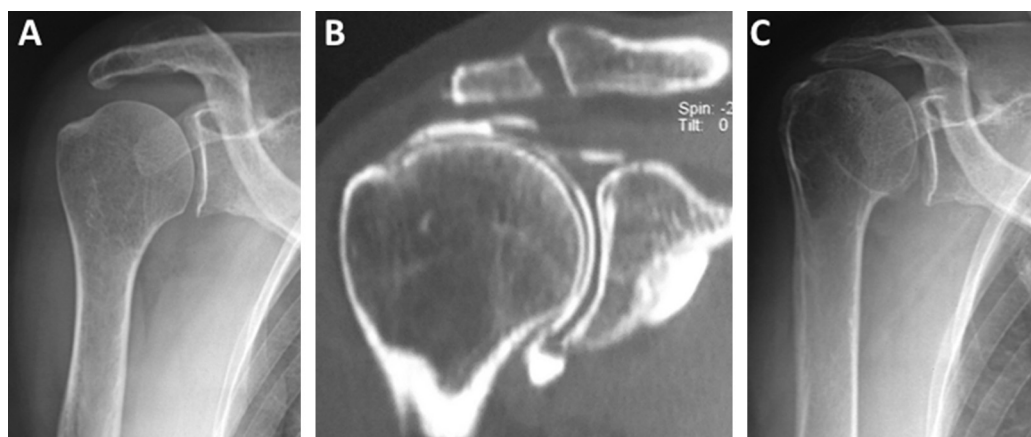


Fig. 1. Poor outcome of an intermediate rotator cuff tear in the absence of tendon suture. A. Preoperative radiograph. B. Preoperative computed arthrotomography: intermediate-size tear. C. Radiograph 4 years after surgery: eccentric position of the humeral head.

4. Discussion

The low complication rate and good overall functional outcomes in our case-series are consistent with the large body of earlier published work [2,8–11] and support surgical treatment in patients older than 60 years of age with symptoms refractory to medical treatment. On the other hand, previous studies fail to determine whether tendon suture should be among the procedures performed in this age group. Combined acromioplasty and biceps tenotomy is effective in providing pain relief when the humeral head is still centred [2]. Nevertheless, several studies indicate a deterioration in mid-term functional outcomes in the absence of tendon suture [2,6,7]. Zvijac et al. [7] reported good outcomes in 84% of patients after 2 years compared to only 68% after 4 years. In several recent studies, 80% to 95% of elderly patients experienced good outcomes after arthroscopic cuff tear suture [8–11,13], but this treatment strategy was not compared to simple decompression. More recently, the French Society for Arthroscopy (Société française d'arthroscopie [SFA]) conducted a prospective comparative study of 154 patients older than 70 years of age with distal-to-intermediate rotator cuff tears and found that tendon suture was superior over simple decompression [12]. In our study of patients older than 60 years, the functional outcomes after arthroscopic rotator cuff repair were better than after simple decompression in the subgroups with intermediate or retracted tears. In contrast to the SFA study, our work showed no statistically significant benefit for distal tears, perhaps because of the small number of patients in this subgroup. Furthermore, Zvijac

et al. [7] reported a longer time to functional outcome deterioration in patients with unrepaired small tears. Thus, a longer follow-up may be needed to evaluate the potential benefits from suturing small tears. These findings are similar to those recorded after 1 year of follow-up in our previous publication [14], indicating that the functional gains are sustained after 4 years with both treatment strategies. Despite the functional gains with CR compared to AT, the increased costs related to the longer operative and hospital-stay times, use of anchors, and more common physical therapist management should be factored into the therapeutic decision.

The healing rate in our study was only 63%, in keeping with the results of most of the other studies in elderly patients [10,13,20–22]. The SFA study in patients older than 70 years, all of whom had distal or intermediate tears, found an 89% healing rate after 1 year [23]. Several reports identified older age as a risk factor for poor tendon healing, related both to decreased tendon-tissue quality [5] and to osteopenia of the greater tuberosity [4]. Charousset et al. [22] also found that tear size affected the healing rate. Our results support this finding, although our sample sizes were too small to produce statistically significant differences. In accordance with Fehring et al. and Charousset et al. [10,22], we obtained better clinical outcomes in patients with healed tendons. This finding indicates a need for optimising the likelihood of tendon healing, both by improving patient selection (tendon appearance, bone quality and tear suture feasibility) and by improving our suture techniques (tendon buttress, growth factors...).

We showed that after tendon suture the AHD remained unchanged after 4 years, contrasting with a significant decrease

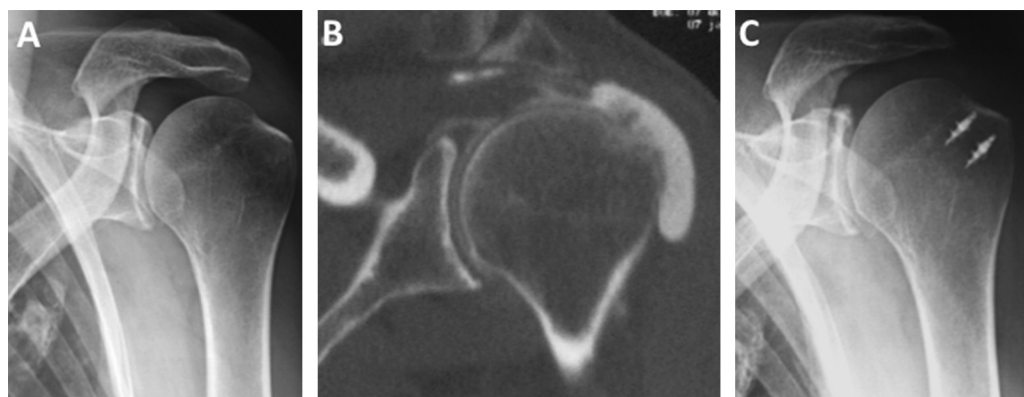


Fig. 2. Good outcome after tendon suture of an intermediate tear. A. Preoperative radiograph. B. Preoperative computed arthrotomography: intermediate-size tear. C. Radiograph 4 years after surgery: the humeral head is centred and the acromio-humeral distance is unchanged.

and greater frequency of eccentric humeral head position in the absence of tendon suture (Figs. 1 and 2). In addition, after 4 years, adverse functional effects were already apparent in patients with humeral head ascension. Similarly, in a 5-year follow-up study of 210 rotator cuff tears treated with acromioplasty, Kempf et al. [3] found significant eccentric humeral head position. Di Schino et al. [24] demonstrated that tendon suture limited the joint and muscle degenerative lesions in the long-term. Our findings suggest that arthroscopic tendon suture in elderly patients may prevent or slow the progression to cuff tear gleno-humeral arthropathy with eccentric humeral head position, thereby probably protecting against further functional impairments in the long-term. Thus, our data strongly support tendon suture in active patients who are still in good general health.

A number of methodological limitations of our study must be acknowledged. The number of patients differed between the two groups, because of the simple randomisation method used and 79% re-evaluation rate. This fact affected the power of our statistical tests. The tendon suture technique was not the same in all patients, as the surgeon chose between single-row and double-row suturing depending on the intraoperative findings. Evaluating the potential influence of the suture technique on the outcomes was not the objective of our study, and whether one of the techniques is superior over the other has been a focus of debate in the literature [25,26], with a particularly high level of controversy at the time our study was initiated. However, in a recent meta-analysis by Xu et al., double-row suturing was associated with better clinical outcomes and tendon healing rates [27]. Therefore, choosing a standard suture technique would probably have been preferable. We evaluated tendon healing using ultrasonography, whose limitations and heavily operator-dependent nature are well established. We therefore classified all heterogeneous tendons as torn, at the possible cost of over-estimating the tear recurrence rate. Prickett et al. [28] established the efficacy of ultrasonography in detecting recurrent tears after tendon repair, showing a high sensitivity of 91%. Nevertheless, magnetic resonance imaging (MRI), although more costly and less widely available, would no doubt have provided a more detailed analysis. Sugaya et al. recommend MRI, suggesting classification of the findings into five categories, with types IV and V indicating recurrent tears [29]. Lastly, the outcomes were evaluated in the mid-term in our study and must therefore be interpreted with caution. A longer follow-up will be needed to confirm that the gains achieved by tendon suture are sustained and to assess the risk of progression to loss of humeral head centring and its consequences.

5. Conclusion

Arthroscopic rotator cuff tendon repair in patients older than 60 years of age provides functional gains in the mid-term compared to decompression alone. After 4 years, the result is not significantly better with tendon suture, however, in patients with small tears. The functional outcome after tendon suture depends on whether the tendon heals, and every effort should therefore be made to achieve this outcome. Tendon suture may also decrease progression to cuff tear gleno-humeral arthropathy with an eccentric humeral head position, and the associated adverse functional consequences, which are already clearly apparent after 4 years, need to be evaluated after a longer follow-up. Acromioplasty-tenotomy also produces good outcomes and this procedure is simpler, less costly, and followed by an easier rehabilitation phase. Thus, acromioplasty-tenotomy deserves consideration in patients with low functional demands and in those with limited motivation to engage in postoperative rehabilitation therapy.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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